1. the absolute value of a cosine: *|H(ej2πf) |*∝*|cos (πfN) |* . In this way, not only can the fundamental but also its frst few harmonics be removed. Select the parameter *N* and the sampling rate so that the frequencies at which the cosine equals zero correspond to 60 Hz and its odd harmonics through the ffth.
2. Find the diference equation that defnes this flter.

**Problem 5.29**: Digital AM Receiver

Thinking that digital implementations are always better, our clever engineer wants to design a digital AM receiver. The receiver would bandpass the received signal, pass the result through an A/D converter, perform all the demodulation with digital signal processing systems, and end with a D/A converter to produce the analog message signal. Assume in this problem that the carrier frequency is always a large even multiple of the message signal's bandwidth *W*.

1. What is the smallest sampling rate that would be needed?
2. Show the block diagram of the least complex digital AM receiver.
3. Assuming the channel adds white noise and that a *b*-bit A/D converter is used, what is the output's signal-to-noise ratio?

**Problem 5.30:** DFTs

A problem on Samantha's homework asks for the **8-point** DFT of the discrete-time signal *δ (n − 1) +δ (n − 7*.*)*

1. What answer should Samantha obtain?
2. As a check, her group partner Sammy says that he computed the inverse DFT of her answer and got *δ (n + 1) +δ (n − 1*.*)*Does Sammy's result mean that Samantha's answer is wrong?
3. The homework problem says to lowpass-flter the sequence by multiplying its DFT by



and then computing the inverse DFT. Will this fltering algorithm work? If so, fnd the fltered output; if not, why not?

**Problem 5.31**: Stock Market Data Processing

Because a trading week lasts fve days, stock markets frequently compute running averages each day over the previous fve trading days to smooth price fuctuations. The technical stock analyst at the Buy-Lo Sell-Hi brokerage frm has heard that FFT fltering techniques work better than any others (in terms of producing more accurate averages).

1. What is the diference equation governing the fve-day averager for daily stock prices?
2. Design an efcient FFT-based fltering algorithm for the broker. How much data should be processed at once to produce an efcient algorithm? What length transform should be used?